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(54) **WATER CONTAINMENT STRUCTURE**

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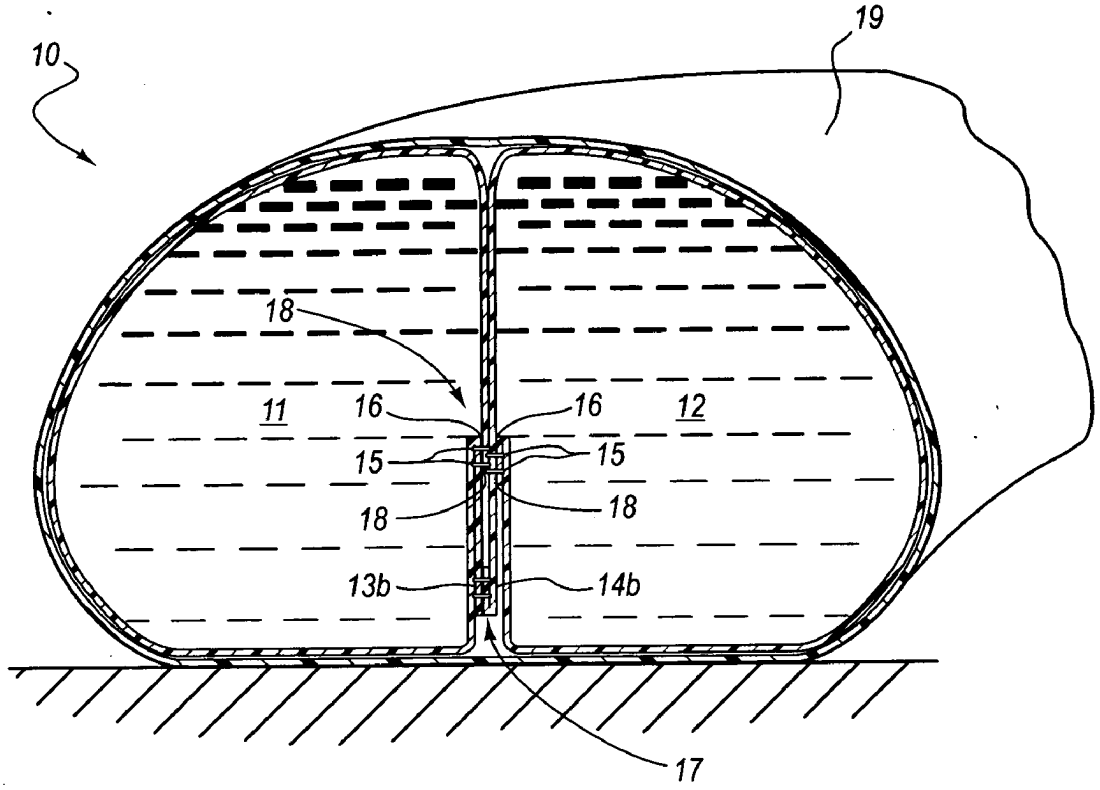
(57) **ABSTRACT**

A water structure that includes at least a pair of sleeves or tubes formed from a puncture resistant flexible material that are each joined to an edge of each of a pair of divider skirt sections that are, in turn, joined to one another along their opposite edges, for installation within an outer sleeve. Which connection of the divider skirt section edges to the sleeves or tubes and to each other is preferably by sewing, but may be provided by heat or adhesive bond, clamping, riveting, or other appropriate method.



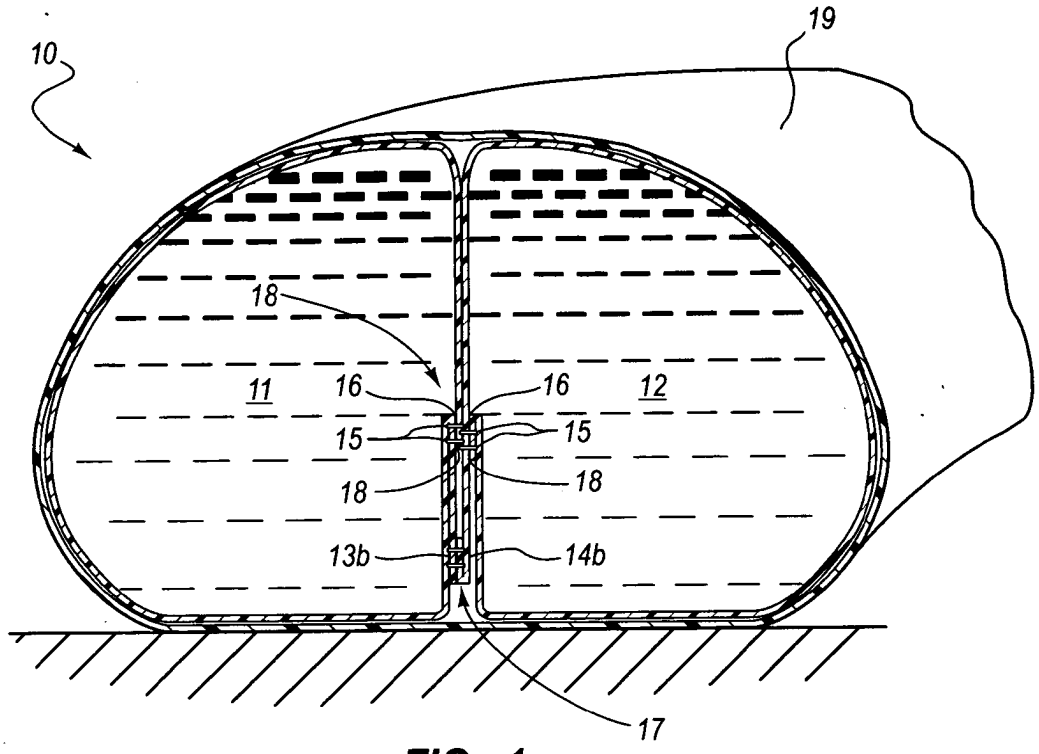

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FIG. 1

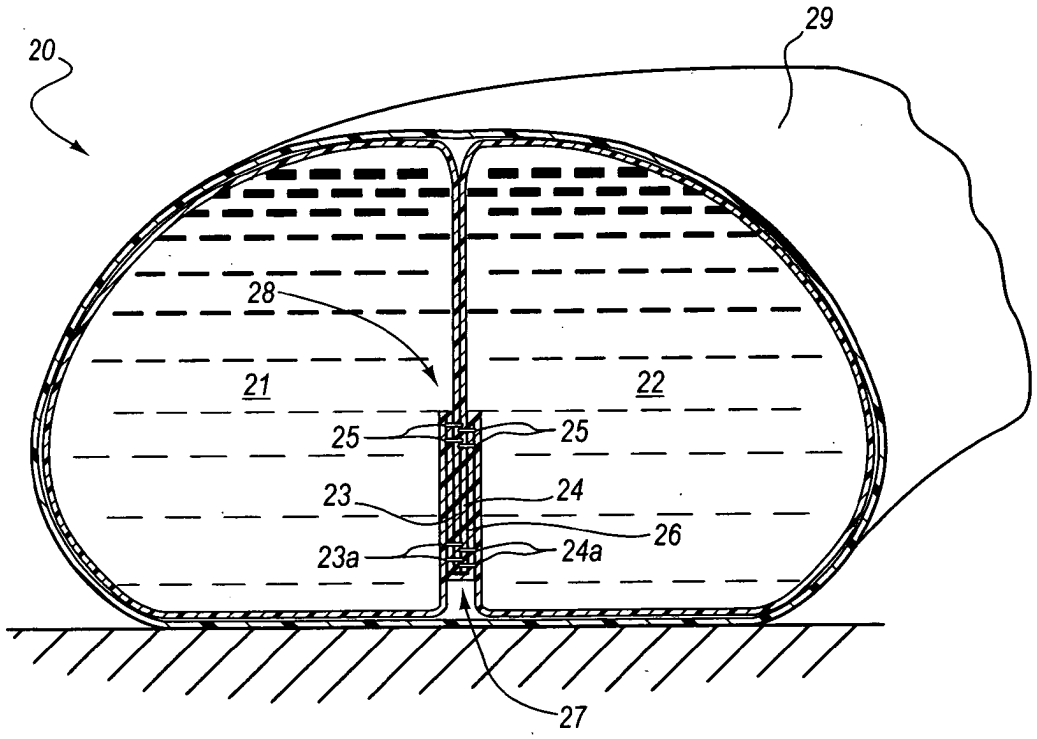
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FIG. 2

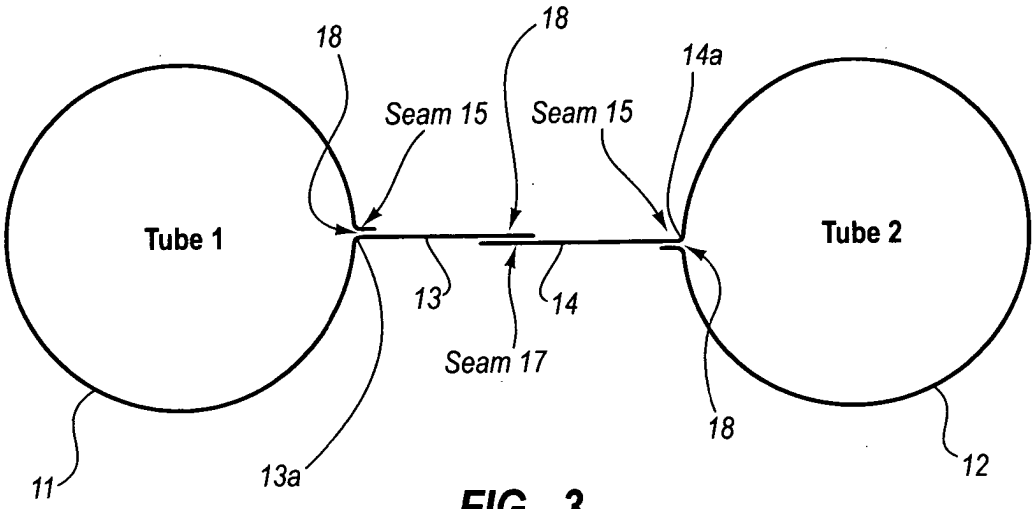

FIG. 3

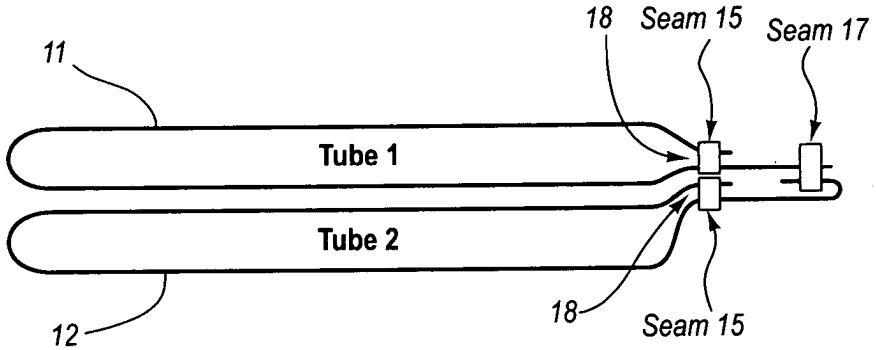

FIG. 4A

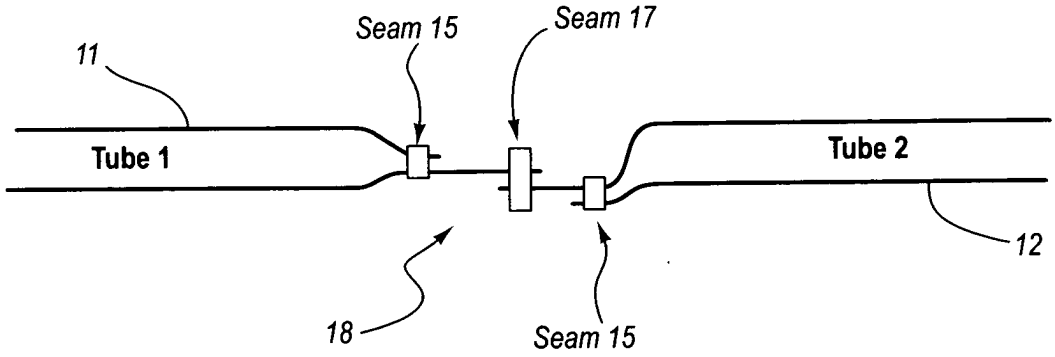

FIG. 4B

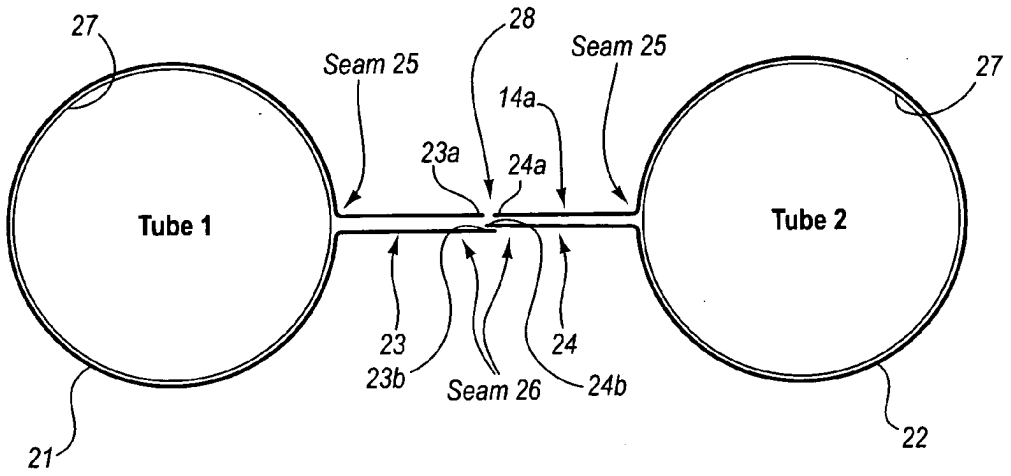

FIG. 5

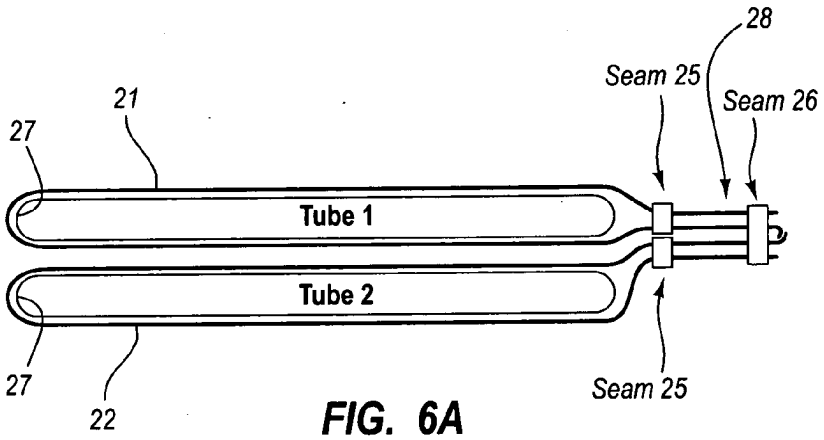

FIG. 6A

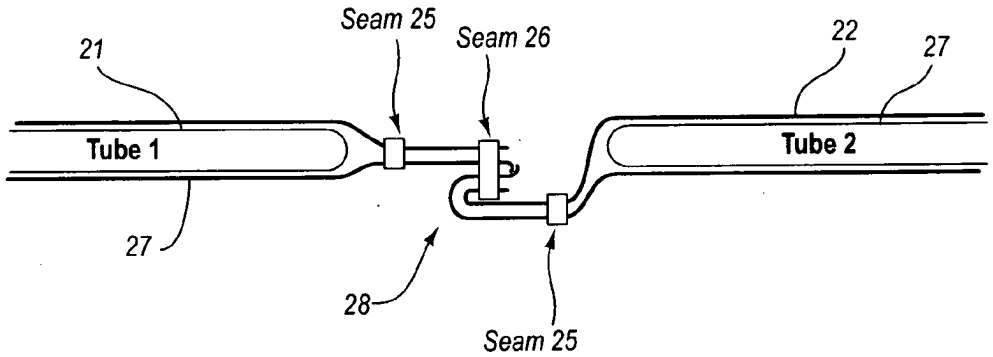

FIG. 6B

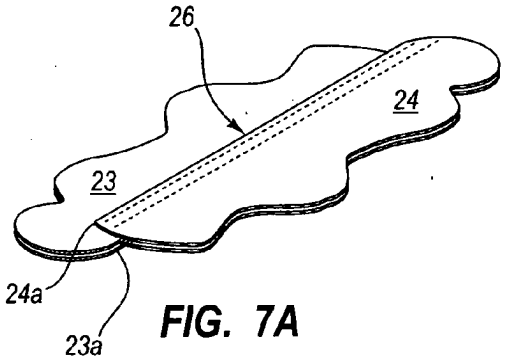

FIG. 7A

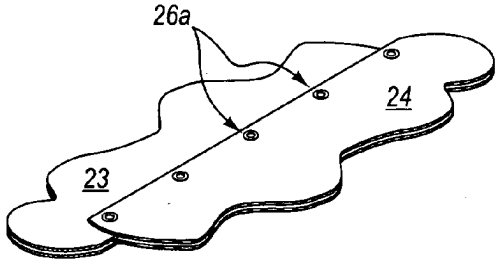

FIG. 7B

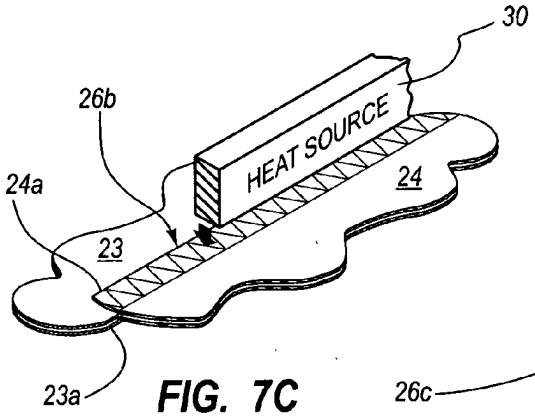

FIG. 7C

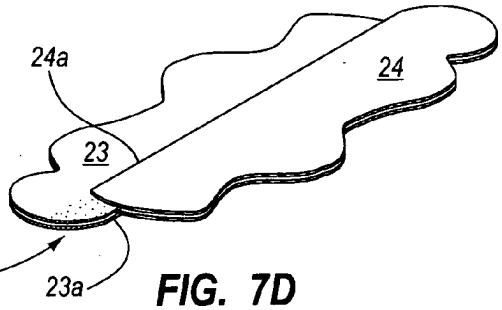

FIG. 7D

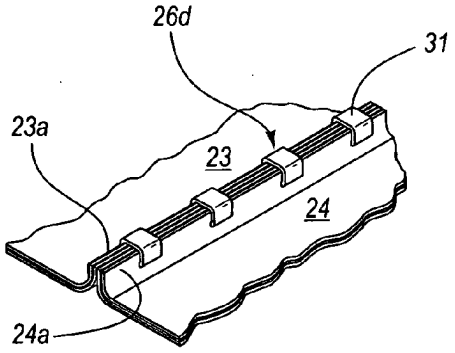

FIG. 7E

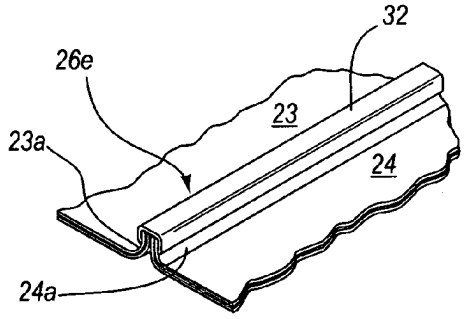

FIG. 7F

WATER CONTAINMENT STRUCTURE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to inside tubes of a water damming structure for damming a water course, controlling and directing water flow, and working and support structures where fabric sleeves are formed and connected together in side by side relationship by a connection arrangement for containment in an outer master tube for forming a variety of structures.

[0003] 2. Prior Art

[0004] A need for a versatile dam structures such that can be water or air filled, and are relatively inexpensive, non-permanent, reusable and durable, have been early recognized by the inventor who has been awarded U.S. Pat. Nos. 5,059,065 and 5,125,767, 6,364,571 and 6,481,028, and is the inventor of a recent U.S. Pat. No. 6,783,300 that shows coupling arrangements for maintaining water structure tubes together, in side by side relationship, along their lengths. The present invention provides additional coupling arrangements to those shown in which earlier patents for joining at least a pair of water structure tubes in side by side relationship along their lengths that, prior to filling, are for arrangement in an outer master tube, providing, when filled with water a dam structure.

[0005] Water structures like those shown in the earlier patents of the inventor and the present invention have been found to be very useful for safely and reliably containing water, for directing water, and have also been used for controlling hazardous waste, oil or chemical spills, for flood control, and the like. Further, such water structures are also appropriate for use, for example, in temporary damming operations such as may be involved in agricultural water storage, construction, for de-watering work sites, fields, or the like, and can even be used as permanent or long term structures.

[0006] Additional to the patents of the inventor cited above, it has heretofore been recognized that fluid filled flexible water control structures and barriers can be used for retention and storage of water, control of water flow and wave action, and a number of configurations of dams and barriers, and such have been formed as both semi-permanent and temporary structures. Some of such other arrangements are shown, for example, in U.S. Patents to: Hornbostel, Jr., U.S. Pat. No. 3,373,568; Sample, U.S. Pat. No. 4,729,691; Brodersen, U.S. Pat. No. 4,799,821; Hendrix, U.S. Pat. No. 5,040,919; Roach, U.S. Pat. No. 5,605,416; Melin, U.S. Pat. No. 5,857,806; and Miller, et al., U.S. Pat. No. 5,865,564. Which above cited U.S. Patents show various containment, dam and barrier configurations from permanent to portable structures, and include, as shown in the Brodersen '821 patent, a structure for encircling a chemical or oil spill. Such earlier patents, however, do not show a flexible sleeve coupling arrangement for connecting two sleeves or tubes through a divider skirt for containment within an outer tube, that is like that shown in the present invention.

[0007] Unlike the present invention, other specialty water filled structures have been earlier employed as shown, for example, in Thompson, U.S. Pat. No. 4,352,591; Sample, U.S. Pat. No. 4,966,491; Taylor, U.S. Pat. No. 4,981,392; Eaker, U.S. Pat. No. 5,785,455, and Strong, U.S. Pat. No. 5,984,577, that have generally involve inflatable envelope arrangements. None of which such earlier structures have provided the unique coupling arrangement of the invention for joining separate sleeves or tubes across a divider skirt along their lengths for fitting into an outer tube and filling with water, producing the strong and reliable water structures like that of the present invention.

BRIEF SUMMARY OF THE INVENTION

[0008] It is therefore a principal object of the present invention to provide a connection arrangement for joining first and second sleeves or tubes in side by side relationship along their lengths, between a divider sheet, for fitting into an outer sleeve and filling with water, forming a dam type water structure.

[0009] Another object of the present invention is to provide a connection arrangement for longitudinally coupling a pair of sleeves or tubes along their adjacent lengths, by sewing, clamping, welding or like fastening of edges of flat first and second divider skirt sections along the length of each of a pair of sleeves or tubes with the outer or first edges of each of the divider skirt sections and which divider skirt sections are positioned alongside one another and are coupled together along their inner or seconds edges, forming a single divider skirt between the pair of sleeves or tubes along their lengths, with the assembly for fitting into an outer sleeve and filled with water.

[0010] Still another object of the present invention is to provide a pair of sleeves or tubes, that can be alike or of different sizes and configurations, where each includes a divider skirt section coupled along a first divider skirt edge to the sleeve or tube along its length and the divider skirt sections, in turn, are connected along their second inner edges, forming a divider skirt, that is for maintaining the sleeve or tubes along their lengths, with the assembly for fitting into an outer sleeve, and which sleeves or tubes are preferably open ended, but can each be permanently closed at one or both ends, with, after filling with water, sleeve or tube open ends are elevated above the water level and can be closed as with a tie, or other appropriate closure device.

[0011] The present invention is in a connection arrangement for joining first and second sleeves or tubes along their lengths to a divider skirt, where each sleeve or tube can be filled with an appropriate liquid, preferably water, after positioning in an outer sleeve. The first and second sleeves or tubes can be arranged to hold water or can contain and maintain at least one flexible bladder that can be filled with water, providing a water structure where the pair of sleeves or tubes are maintained together within the outer sleeve, providing a water structure that with the first and second sleeves or tubes filled with water, will resist being rolled when subjected to a side or transverse hydraulic load directed against one face of the water structure. The respective sleeves or tubes can be formed to have the same or different diameters and lengths.

[0012] The sleeve or tube connection arrangement includes a pair of flat flexible divider skirt sections, with one divider skirt section provided for each sleeve or tube. Each divider skirt section preferably has a rectangular shape and each is for attachment along one long first edge to each of the sleeves or tubes as with a fastener, and the opposite divider skirt section long section edges are for coupling together, joining the divider skirt sections into a single divider skirt that maintains the first and second sleeves or tubes together across the divider skirt.

[0013] The individual skirts can be secured along the length of the sleeve or tube in a factory or manufacturing setting as by sewing, welding, gluing, crimping metal clamps, or the

like, to sandwich the skirt edge between the sleeve or tube, or by any appropriate coupling arrangement. The pair of sleeves or tubes with attached divider skirt sections can then be connected by coupling the divider skirt sections along their second edges together in which factory or manufacturing setting as by sewing, welding, gluing, crimping metal clamps or the like, to sandwich the divider skirt section edges together into a divider skirt, or they can be joined at a work site by an appropriate attachment arrangement, joining the first and second sleeves together in side by side relationship. Whereafter, tubes or sleeves and connected divider skirt that has be flowed upon itself are fitted into an outer sleeve and, in preparation for the sleeves or tubes being filled with a liquid and the sleeve or tube ends closed or maintained above a water level, the sleeves or tubes are filled with water forming the water structure.

[0014] In practice, sleeves or tubes connected along their longitudinal axis by a divider skirt are closed together, folding the divider skirt upon itself, and are fitted into an outer sleeve prior to filling the sleeves or tubes with a liquid, preferably water. Prior to installation, the sleeves or tubes preferably receive inserts or bladders fitted therein, or can receive a coating material applied there over to make them water tight. The sleeves or tubes are preferably woven and the inserts fitted in each sleeve or tube are preferably a polyurethane, or like suitable plastic material, having a range of wall thickness of from five (5) to twenty (20) millimeters. Though, it should be understood, the invention is not limited to any particular sleeve or tube, can utilize inserts of greater or lesser wall thickness, and the outer sleeves or tubes can themselves be constructed to hold water, as can the outer sleeve, within the scope of this disclosure.

DESCRIPTION OF THE DRAWINGS

[0015] In the drawings which illustrate that which is presently regarded as the best mode for carrying out the invention:

[0016] FIG. **1** is an end elevation perspective view of a pair of sleeves or tubes of the invention maintained in side by side relationship between a divider skirt, with the assembly fitted into an outer sleeve and filled with water, where the divider skirt is formed from divider skirt sections whose inner edges are shown as having been fitted over one another and connected by sewing, as illustrated by broken lines, and whose outer edges are shown connected along the sleeves or tubes sides by sewing, illustrated by broken lines;

[0017] FIG. **2** is an end elevation perspective view of a pair sleeves or tubes that are formed by folding flat sheets of sleeve or tube material and joining the contacting surfaces, as by sewing, forming the sleeves or tubes, and showing the flat sheets edges positioned over one another and connected, as by sewing, forming a divider skirt between the sleeves or tubes, and with the sleeves or tubes and divider skirt shown fitted into an outer sleeve and filled with water;

[0018] FIG. **3** is an end elevation schematic view of the sleeves or tubes of FIG. **1** with the divider skirt sections sewn onto the sleeves or tubes sides, extending the length of each, with the inner divider skirt section edges overlapping and connected together by sewing;

[0019] FIG. **4**A shows a side elevation view of the tubes or sleeves of FIG. **3**, that are arranged in side by side relationship and are connected, respectively, to sides of divider skirt sections as by sewing, and showing the inner divider skirt section edges as over lapping and are connected as by sewing;

[0020] FIG. **4**B shows one of the tubes or sleeves of FIG. **4**A pivoted around the other, conforming to the water structure of FIG. **3**;

[0021] FIG. **5** is an end elevation schematic view of the sleeves or tubes of FIG. **2** where the flat sheets of sleeve or tube material are folded upon one other and connected together forming the individual sleeves or tubes and with the flat sections edges laid over one another and showing the edges connected, forming a divider skirt between the sleeves or tubes, and showing each sleeve or tube as including a bladder fitted therein, extending the length of each of the sleeve or tubes;

[0022] FIG. **6**A shows a side elevation schematic view of the sleeves or tubes formed by joining the flat sections of sleeve or tube material into the individual sleeves or tubes as by sewing, and showing the divider skirt formed by joining the parallel edges of the flat sections of material together as by sewing and showing each sleeve or tube as having received a bladder fitted therein;

[0023] FIGS. **6**B shows an end elevation view of the sleeves or tubes of FIG. **6**A that have been joined together by sewing, showing the sleeves for tubes as having received bladders fitted therein, and showing one sleeve or tube pivoted around the other; and

[0024] FIGS. **7**A through **7**F show examples of coupling arrangements for joining the first edges of divider skirt sections along the sides of the sleeves or tubes and for joining the overlapping second edges of the divider skirt sections into a divider skirt that extends between the sleeves or tubes.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Heretofore temporary water structures have included sleeves and tubes that have generally been assembled on site and filled with water to function as a dam, or the like. Like such earlier arrangements, the present invention is in an arrangement of flexible plastic sleeves or tubes that are filled with a liquid, preferably water, and can be utilized for water containment, water diversion, de-watering of a flooded area, and the like.

[0026] The invention is in a sleeve or tube attachment structure for connecting a pair of flexible water impervious sleeves or tubes in spaced arrangement across a divider skirt. Such sleeves or tubes are held together by an outer sleeve to be filled with water, or other liquid, and, prior to filling, each can accommodate a bladder fitted therein. The sleeves or tubes each with, or without a bladder, are maintained within the outer sleeve, and have their ends closed or have their ends maintained above the water level, forming a water structure, such as a dam. Such sleeve or tube connection arrangement provides for securing opposite first divider skirt section edges along the lengths of each sleeve or tube and securing the second divider skirt section edges together, forming the divider skirt, maintaining the pair of sleeves or tubes in position across the divider skirt. The invention is in a preferred sleeve or tube connection arrangement that is shown herein as sewing, but can also include, welding, gluing, a use of grommets and ties, metal clamps, and the like, within the scope of this disclosure.

[0027] FIG. **1** shows an end perspective sectional view of a water structure **10** that includes a pair of sleeves or tubes **11** and **12** that connect, along their opposite longitudinal surfaces, to divider skirt sections **13** and **14**, and with the assembly contained in an outer sleeve **19**. The pair of sleeves or tubes **11** and **12** are shown as connected along their sides to

first edges **13***a* and **14***a* of the divider skirt sections **13** and **14**, respectively, illustrated by seams **15**. FIG. **3** is an end schematic view of the water structure **10** of FIG. **1** that shows the divider skirt sections each connected along their first edges **13***a* and **14***a,* respectively, to the sleeves or tubes **11** and **12** along the tubes or sleeves sides, respectively, as illustrated by seam **15**. Which coupling of the divider skirt edges along the sleeves or tubes **11** and **12** sides may be by a coupling arrangement other than by sewing, such as by welding, bonding, clamping and the like, as illustrated in FIGS. **7**A through **7**F, as discussed below. Which connection arrangement is selected to provide for couplings that are strong and flexible, forming a desired shape of sleeves or tubes **11** and **12** and connected divider skirt **18**, as shown in FIG. **1**, **3**, **4**A and **4**B, that is puncture and tear resistant. Which sleeves or tubes **11** and **12**, divider skirt **18** and outer sleeve **19** material can be a section of thick plastic material such as polyethylene, but is preferably a section of a mesh material that is a weave of plastic stripes, or like material, having strong tensile strength, and providing a weave that is tear resistant. In practice, a material known as woven polypropylene geotextile has been used for forming the tubes or sleeves, divider skirt sections and outer sleeve of the invention.

[0028] As shown in FIG. **1**, water structure **10** can be formed as a pair of individual sleeves or tubes **11** and **12** with the edges **13***a* and **14***a* of divider skirt sections **13** and **14** sewn onto each of the single sleeves or tubes, illustrated by seams **15**, forming a junction of the sleeve or tube sides with the divider skirt section edges, with the assembly for fitting into the outer sleeve **19**, respectively, whereafter the sleeves or tubes **11** and **12** are filled with water, forming the water structure **10**. To provide sleeves or tubes **11** and **12** that will hold water, a sealing material, shown at **16** in FIG. **1**, if needed, may be applied, as needed, within each sleeve or tube, to seal the seam junction, and, this or other sealing material can be spread over the sleeve or tube interior surfaces, water proofing the sleeves or tubes.

[0029] Shown in FIGS. **3**, **4**A and **4**B, the pair of sleeves or tubes **11** and **12**, are arranged in side by side relationship, with each sleeve or tube **11** and **12** contained in outer sleeve **19**, as shown in FIG. **1**, to contain water. In practice, the sleeves or tubes **11** and **12** in outer tube **19**, will have their ends tied off, or their ends may be left open with the sleeve or tube ends maintained at a height above a level of water in which sleeve or tube, forming water structure **10**. The seam **15** joining the divider skirts edges **13***a,* **14***a,* along the sides of the sleeves or tubes **11** and **12**, and the seam **17** connecting the opposite second divider skirt sections edges **13***b* and **14***b,* are preferably triple longitudinal stitches that utilize a thread that is very strong in tension, such as a Kevlar thread, and the junction of the sleeves or tubes sides with the divider skirt edges **13***a* and **14***a* may be sealed as with an application of a sealing adhesive **16** applied within the sleeves or tube. Such junctions, however, may be made utilizing methods other than sewing within the scope of this disclosure. For example, FIGS. **6**B through **6**F show connection arrangements that are, in addition to the seam connection set out above and in FIG. **6**A, and may be utilized for joining the divider skirt sections to each other to form the divider skirt **18**, and to join the divider skirt sections to the sleeves or tubes.

[0030] A water structure **20** is shown in FIG. **2** that is similar to water structure **10** and is also preferably formed by sleeves or tubes **21** and **22** that are linked along their sides through a divider skirt **28** and are contained in an outer sleeve **29**. Like the divider skirt **18** of FIG. **1**, the divider skirt **28** is also formed from connected divider skirt sections **23** and **24** at their first edges **23***a* and **24***a.* The tubes or sleeves **21** and **22** are preferably formed materials like those described above with respect to sleeves or tubes **11** and **12**, that are shown as separate flat sheets of material that are each folded upon itself and are connected along a mid-line, shown as seam **25**, to form each of the sleeves or tubes **21** and **22** and connected divider skirt sections **23** and **24**. Within the scope of this disclosure, however, the two sleeves or tubes **21** and **22** and the divider skirt sections **23** and **24** can be formed from a single sheet of material. In such arrangement, the folded flat sheets of material are joined, as by sewing, shown as seams **25**, forming the sleeves or tubes **21** and **22**, and each sleeve or tube receives a bladder **27** fitted therein prior to filling with water. The divider skirt sections **23** and **24** first edges **23***a* and second edges **23***b* and **24***a* and **24***b,* respectively, are fitted together and are joined, as by sewing as shown at seam **26**, forming divider skirt **28**.

[0031] Where the water structure **10** of FIG. **1** shows the sleeves or tubes **11** and **12** as formed or arranged to contain water, the sleeves or tubes **21** and **22** are shown in FIG. **5**, **6**A and **6**B as having separate bladders **27** fitted therein that are filled with water, as shown in FIG. **2**. Though, it should be understood the sleeves or tubes **11** and **12** could also receive bladders fitted therein, or the Sleeves or tubes **21** and **22** could be arranged for contain water without an inclusion of bladders, within the scope of this disclosure.

[0032] FIGS. **4**A and **4**B show an example of assembly of the sleeves or tubes **11** and **12** and the divider skirt **18**, illustrating that the sleeves or tubes can be stacked together while the junctions are sewn, show as seams **15** and **17**. Whereafter, the sleeves or tubes **11** and **12** are pivoted, as shown in FIG. **4**B for positioning in the outer sleeve **19** and filling with water, as shown in FIG. **1**, forming water structure **10**. Similarly, FIGS. **6**A and **6**B also show the stacked sleeves or tubes **21** and **22** that are connected to opposite first edges of divider skirt **28** as by sewing, illustrated as seams **25** and **26** and, additionally, show bladders **27** as having been fitted into the sleeves or tubes **21** and **22**. Whereafter, the sleeves or tubes **21** and **22** are pivoted, as shown in FIG. **6**B for positioning in the outer sleeve **19** and filling with water, forming the water structure **20**.

[0033] As described above, a preferred coupling arrangement for joining the divider skirt sections edges onto the sleeves or tubes, extending the length of which sleeves or tubes, and the divider skirt sections second edges onto one another, is by sewing. FIG. **7**A illustrates this coupling arrangement, showing the divider skirt sections **23** and **24** first edges **23***a* and **24***a* as overlapping and shows seam **26** as joining the divider skirt sections along their second edges, forming the divider skirt **28**.

[0034] Alternatively, the connection of the divider skirt section edges onto the sleeve or tube, along the length of the sleeve or tube, and for joining the divider skirt sections opposing edges, forming the divider skirt, can be accomplished by a utilization of the connection arrangements shown in FIGS. **7**B through **7**F. In FIG. **7**B the overlapping edges of the divider skirt sections **23** and **24** are shown connected by rivets **26***a,* and in FIG. **7**C divider shirt sections **23** and **24** first edges **23***a* and **24***a* are shown interfolded and a layer of heat activated glue, **26***b* is applied to the edges **23***a* and **24***a* that receives a heat source **30** moved therealong, activating the glue layer to provide bonding or welding of the divider skirt

edges together. FIG. **7**D shows divider skirt sections **23** and **24** first edges **23***a* and **24***a* as having received a layer of an adhesive **26***c* applied to the opposing edge surfaces, gluing the divider skirt sections together. FIG. **7**E shows the first edges **23***a* and **24***a* of the divider skirt sections **23** and **24** as having been folded together, illustrated by arrow **26***d* and clamped together at spaced intervals by crimping clamps **31**. FIG. **7**F shows a connection arrangement that is functionally like that shown in FIG. **7**E. Shown in FIG. **7**F, the first edges **23***a* and **24***a* of the divider skirt sections **23** and **24** are shown as having been folded together, illustrated by arrow **26***e* and clamped by a single crimping clamp **32**. Which clamps **31** and **32** of FIGS. **7**E and **7**F, it should be understood, can be in turned at the end of their parallel sides to bit into, so as to more securely hold the divider skirt sections edges together.

[0035] Although preferred embodiments of the invention have been shown and described herein, it should be understood that the present disclosure is made by way of example only and that variations are possible, within the scope of this disclosure, without departing from the subject matter coming within the scope of the following claims and reasonable equivalency thereof, which claims I regard as my invention.

I claim:

1. A water structure comprising, at least a pair of sleeves or tubes formed from a flexible material selected to resist punctures; a pair of like flat flexible rectangular divider skirt sections that each have a length to extend the length of each said sleeve or tube, and are of a width to extend out from a side of said sleeve or tube; means for securely connecting first edges of each said divider skirt section along each said sleeve or tube outer surface, along its longitudinal axis; means for connecting second edges of each said divider skirt section to each other, forming a divider skirt that extends between the sides of said sleeves or tubes: and an outer sleeve for containing said pair of sleeves or tubes and divider skirt.

2. The water structure as recited in claim **1**, wherein the means for securely connecting said pair of divider skirt sections first edges onto sides of each of said sleeves or tubes, along the length thereof, is by sewing with a thread having a strong tensile strength.

3. The water structure as recited in claim **1**, wherein the means for connecting second edges of each said divider skirt to each other is by sewing with a thread having a strong tensile strength.

4. The water structure as recited in claim **1**, wherein the means for securely connecting said pair of divider skirt sections first edges onto sides of each of said sleeves or tubes, along the length thereof, and for connecting second edges of each said divider skirt to each other is by bonding or welding.

5. The water structure as recited in claim **4**, wherein the bonding or welding is provided by application of a heat source onto the contacting sleeve or tube and divider skirt section surfaces to create a flow of material to provide bonding or welding at the location of said heat source application.

6. The water structure as recited in claim **4**, wherein the bonding or welding is provide by application of an adhesive between said sleeve or tube and divider skirt section surfaces and curing said adhesive.

7. The water structure as recited in claim **1**, wherein the means for securing connecting said pair of divider skirt sections first edges onto sides of each of said sleeves or tubes, along the length thereof, and for connecting second edges of each said divider skirt section to each other is by clamping the contacting sleeve or tube and divider skirt sections surfaces by pinching parallel legs of a channel shaped metal clamp together across said contacting surfaces.

8. The water structure as recited in claim **7**, wherein the channel shaped metal clamp is the length of the junction of the sleeve or tube side with the divider skirt section edge, and the divider skirt sections second edges.

9. The water structure as recited in claim **7**, wherein the a plurality of channel shaped metal clamps are individually clamped at spaced internals along the junctions of the sleeve or tube side and the divider skirt first edge and the overlapped portions of the divider skirt sections second edges.

10. The water structure as recited in claim **1**, further including, a seal is fixed along the junction of the sleeve or tube surface and the divider skirt section first edge within the sleeve or tube.

11. The water structure as recited in claim **11**, further including fitting a tubular bladder within each of the sleeves or tubes.

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